The Emerging Epidemic of Melanoma and Squamous Cell Skin Cancer

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Squamous cell skin cancer, though common, remains largely unreported and unstudied, with little known about its incidence and time trends. We have used a unique resource—a continuous population-based registry of cases of squamous cell skin cancer within a single prepaid health plan—to describe basic epidemiologic features of this malignancy and compare it with the more widely studied melanoma. Both malignancies are considerably more common in this population than we expected based on previous reports from the general population. From the 1960s to the 1980s, the incidence of squamous cell skin cancer increased 2.6 times in men and 3.1 times in women, while incidence of melanoma rose 3.5-fold and 4.6-fold in men and women, respectively. Skin cancers of both types involving the head and neck or the extremities increased essentially in parallel over these 27 years. Melanomas of the trunk, however, appeared to increase at a faster rate in both sexes. These observations are consistent with the impression that the rising incidence of both malignancies may be attributable to increased voluntary exposure to the sun over an extended period.

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SQUAMOUS cell skin cancer, though it affects thousands of men and women each year, is customarily not reported to tumor registries in the United States. The incidence of such cancers, which are usually treated in the outpatient setting, is difficult to ascertain and even the most basic demographic information has only been available from two special surveys mounted by the National Cancer Institute.[1,2]

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If basic descriptive data are rare, data to evaluate time trends in the incidence of this disease are even more scarce. Indeed, the only study available compares trends in rates over only 5 to 6 years.[1]

By contrast, descriptive and time-trend information about melanoma is readily available[3-5] and there is great concern about the rising incidence of this malignancy.

From an etiologic perspective, squamous cell skin cancer clearly seems to be related to sun exposure—it is more common among fair-skinned individuals, especially those with frequent or long-term exposure to sunlight, including those who live at southern latitudes.[1] The relationship of melanoma to the sun seems more complex than one of simple total exposure[6] and may involve such elements as the age at exposure and the degree of sunburn.[7,8]

Herein, we report changes in incidence of squamous cell skin cancer and malignant melanoma from the same population-based registry in a large prepaid health plan.

METHODS

Kaiser Permanente (KP) is a large prepaid health insurance program currently serving more than 300 000 Kaiser Health Plan members in the Portland, Ore–Vancouver, Wash, area. This organization has been in continuous existence since 1941. Current facilities include two hospitals and a number of outpatient clinics at which Northwest Permanente, the physician group serving KP members, provides the full range of medical care for KP members. Patients may use community physicians, but, in the area of cancer treatment, virtually all care is provided within the facilities and by the staff of KP.

Dermatologists and surgeons at KP have been the physicians principally involved in the treatment of patients with skin cancers. It has been standard practice over the years to send essentially every specimen removed from the skin to the pathology department at KP for microscopic examination.

The sample for this report (Table 1) includes cases of squamous cell skin cancer and of cutaneous melanoma diagnosed among KP members for the period 1960 through 1986. Any cancers diagnosed prior to membership in KP were not considered.

Reports of cases of melanoma came from the routinely maintained files of the KP tumor registry. Though collection of squamous cell cases was not mandated by the American College of Surgeons, the accrediting body for tumor registries, it had been routine since 1960 for the KP registry to collect all pathology reports of cancer. The squamous cell skin cancer cases described herein came from this unique file. All cases of melanoma, and, by definition, all cases of squamous cell skin cancer, had been microscopically confirmed. Using descriptive material attached to the pathology report and review of the medical record

Table 1.—Skin Cancer Sample, 1960 to 1986, by Cell Type, Sex, and Primary Site

	Squamous Cell		Melanoma	
	Males	Females	Males	Females
Head and neck	1082	350	86	67
Trunk	64	25	128	79
Extremities	233	120	52	149
Site not specified	1	1	10	6
Total	1380	496	276	301

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when necessary, registrars noted the primary site of each cancer. We only included primary sites in the skin, excluded mucosal and paramucosal lesions, and grouped cases into three broad categories as follows: head and neck, trunk, and extremities. Two cases of squamous cell skin cancer and 16 cases of melanoma could not be accurately assigned to a particular site because of a lack of documentary material in the record.

The KP tumor registry ascertained 1876 cases of invasive squamous cell skin cancer and 577 cases of invasive malignant melanoma during this 27-year period. During this time 399 noninvasive squamous cell cancers and 61 noninvasive melanomas also occurred.

Our report follows the standard convention[3] of counting each lesion as a separate primary cancer if the lesions were clinically distinct. Registrars of KP followed the conventions of the American Joint Committee on Cancer and the American College of Surgeons as specified in their staging manual for tumor registries.[9] Thus, simultaneous distinct cancers and second (or third) cancers developing subsequently were counted as primary tumors. Locally recurrent cancers were specifically excluded. The incident cases of invasive and noninvasive squamous cell skin cancer (n = 2275) occurred among 1794 members of KP. There were 223 individuals who developed at least two cancers (71 in the same year and 152 in subsequent years) and 25 members who developed five or more cancers. Among the 638 patients with invasive and noninvasive melanoma, 15 had 2 cancers (7 in the same year and 8 subsequently), and 1 patient had 11 malignancies removed. For this report we have only considered invasive disease.

Population figures came from data routinely compiled by KP on its members. These figures have been repeatedly verified—they are updated monthly and used on a daily basis by KP administrators. We calculated incidence rates by applying figures taken from the tumor registry to the population at risk—the relevant subgroup of KP for the particular age, sex, and year of interest. Using the 1970 Standard Million and age adjustment by the direct method, we were able to compare overall rates at different times with each other, as well as compare KP figures with published rates from other registries. Further, age adjustment corrected for changes in the KP population during the long period of observation of this study.

The KP health plan has grown steadily over the years. Since 1980 there has been an increase in the proportion of members more than 65 years of age. These older individuals have been enrolled in several programs particularly aimed at the "Medicare age group." The rest of the membership reflects the employed population of the Portland metropolitan area. Individuals at the extremes of social class tend to be underrepresented. Nonwhites account for only about 6% and Hispanics for less than 3% of the population of this area. Hence, this report describes the epidemiology of skin cancer of a largely white population.

RESULTS

The incidence of squamous cell skin cancer rises with advancing age in both men and women (Table 2). Rates for men are 3.4-fold higher overall than those for women. The incidence for both sexes begins to rise sharply around age 40 to 45 years and climbs steadily thereafter. On the other hand, using these cross-sectional incidence data, melanoma rates are very similar in men and women. The age-specific rate rises sharply between adolescence and early adulthood but increases only slowly thereafter. (We include the rates for each 5-year age group up to 85 years for squamous cell cancer, but group those over 65 years for melanoma because of small numbers at these older ages.)

Table 2.—Age-Specific Incidence (Rate per 100 000) of Skin Cancer by Type of Malignancy, Sex, and 5-Year Age Groups: Invasive Cancers Only

	Females		Males	
Age Group, y	No.	Rate	No.	Rate
Squamous Cell Skin Cancer				
0-19	5	0.6	0	0.0
20-24	1	0.5	1	0.7
25-29	0	0.0	4	2.4
30-34	2	1.0	4	2.2
35-39	5	3.1	11	7.1
40-44	13	9.8	29	22.8
45-49	14	12.2	45	40.9
50-54	35	31.7	82	80.8
55-59	32	30.2	136	144.8
60-64	52	55.4	185	222.3
65-69	74	99.7	263	413.7
70-74	63	112.4	237	523.3
75-79	85	228.4	189	699.6
80-84	60	282.1	103	751.3
85+	53	419.0	90	1371.3
Total	496	21.3	1379	63.8
Adjusted rate	...	23.8	...	81.2
Melanoma				
0-19	5	0.6	2	0.2
20-24	11	5.8	8	5.5
25-29	24	11.6	10	5.9
30-34	31	16.0	19	10.6
35-39	34	20.9	31	20.1
40-44	23	17.3	32	25.2
45-49	34	29.5	23	20.9
50-54	26	23.6	22	21.7
55-59	23	21.7	35	37.3
60-64	28	29.8	20	24.0
65+	56	27.8	64	41.0
Total	295	12.7	266	12.3
Adjusted rate	...	12.7	...	13.4

When considered by primary site, the incidences of squamous cell cancers of the head and neck, extremities, or trunk all rise with advancing age and at approximately the same rates (Fig 1). In the latter two categories there were no cases in people below the age of 35 years, but the incidence subsequently parallels that for lesions of the head and neck. On the other hand, rising incidence with age is apparent for melanoma of the head and neck (Fig 2) but not for trunk lesions and probably not for lesions of the extremities. For both of these latter sites, after rising rapidly to about age 40 years, the rates remained relatively stable thereafter.

The total incidence of squamous cell skin cancer and of melanoma has in-

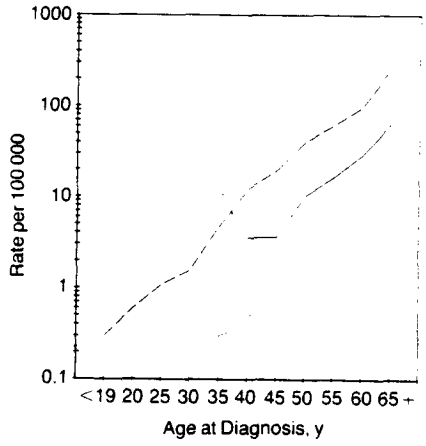

Fig 1.—Age-specific incidence of squamous cell skin cancer, both sexes, by primary site of malignancy. Solid line indicates extremities; dashed line, head and neck; and dotted line, trunk.

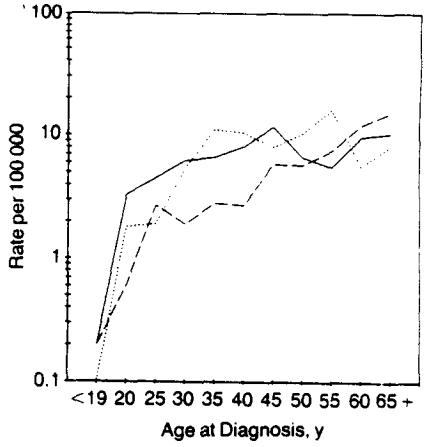

Fig 2.—Age-specific incidence of melanoma, both sexes, by primary site of malignancy. Solid line indicates extremities; dashed line, head and neck; and dotted line, trunk.

creased markedly in the last 27 years (Table 3). (Because of relatively small numbers in the earlier years of observation, we pooled the incidence rates into two 10-year periods, 1960 through 1969 and 1970 through 1979, and one 7-year period, 1980 through 1986.) Incidence of squamous cell cancer has risen 3.1 times between the first and last period of observation among women and 2.6 times among men. Over the same period, incidence of melanoma has gone up 3.5 times in women and 4.6 times in men.

Increases in rates were seen among both sexes for squamous cell cancer and melanoma for each of the three anatomic site groupings evaluated (Fig 3). The upward trend in rates was statistically significant ($P<.05$) for each of the 12 groupings in Fig 3 with the exception of squamous cell cancers of the trunk in women, where the twofold increase was based on only 25 cases over the entire 27-year study period. The relative positions of the curves for both melanoma and squamous cell skin cancer arising on the extremities or on the head and neck remained unchanged over time, indicating similar rates of increase.

The rates of increase (slopes of the regression lines) for all 12 groupings were not significantly different from each other. However, the incidence of melanomas of the trunk appeared to rise particularly sharply during this time. At the earliest period, for both men and women, squamous cell disease exceeded melanoma in incidence. Twenty years later the relative positions have reversed. The truncal melanoma rate for women rose from 0.5 to 4.5 per 100 000 while that for squamous cell disease of the trunk increased from 0.7 to 1.3 per 100 000. For men the truncal melanoma rate changed from 0.8 to 9.3 per 100 000 while the squamous cell rate increased from 1.3 to 5.6 per 100 000.

The patterns noted here for both melanoma and squamous cell skin cancer were not confined to rising incidence for a particular age group. We examined incidence rates for both malignancies by site and age at diagnosis, dividing the sample into three broad categories—20 through 44 years, 45 through 59 years, and 60 or more years at diagnosis. Increases in rates were similar for the three age groups examined with each category contributing proportionately to the overall rising incidence.

Table 3.—Incidence of Skin Cancer by Type of Cancer, Sex, and Calendar Period

	Age-Adjusted Rates per 100 000, SE (No. of Cases)	
	Females	Males
Squamous cell		
1960 to 1969	9.7±2.05 (33)	41.6±4.18 (124)
1970 to 1979	21.0±1.71 (154)	76.9±3.78 (452)
1980 to 1986	29.8±1.71 (308)	106.1±3.79 (803)
Melanoma		
1960 to 1969	4.9±1.11 (20)	4.4±1.56 (13)
1970 to 1979	10.6±1.10 (97)	10.2±1.21 (77)
1980 to 1986	17.0±1.32 (178)	20.1±1.55 (176)

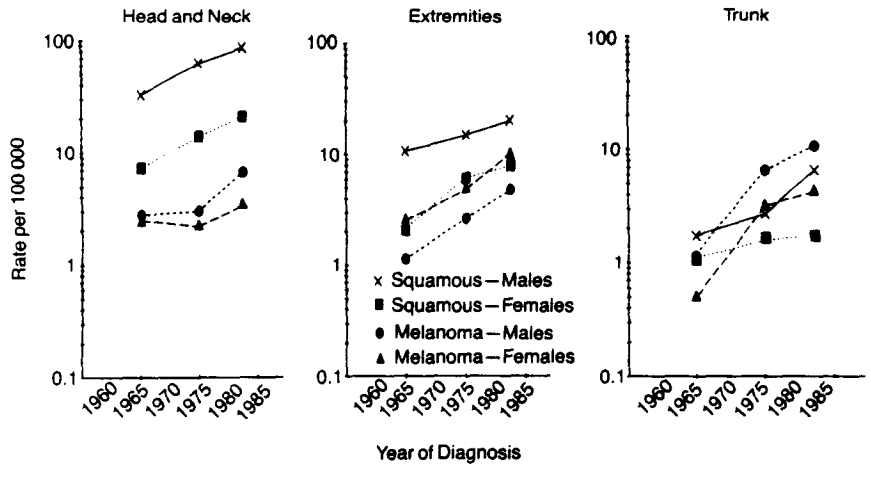

Fig 3.—Age-adjusted incidence of squamous cell skin cancer and melanoma, by date of diagnosis and primary site of malignancy.

COMMENT

Incidence rates of squamous cell skin cancer and melanoma have risen threefold to fourfold over the last 27 years within this particular prepaid health plan. This has been true for both men and women and for cancers at all anatomic sites. These epidemic increases have been described before for melanoma, but, because of the lack of systematic reporting over time of nonmelanomatous skin cancer, the increases for this malignancy have gone undescribed until now. The rates for melanoma and squamous cell skin cancer of the head and neck and of the extremities have generally risen in parallel over time, while the rate for melanoma of the trunk has risen at a more rapid rate than that for any other site. In the early 1960s, the rate of truncal melanoma for both men and women was less than that for squamous cell skin cancer. For both sexes, the melanoma rate at this site now considerably exceeds that of squamous cell skin cancer.

Aside from the magnitude of the increases, another disturbing aspect of the current study is the magnitude of the rates themselves. For squamous cell cancers we compared the KP rates for 1975 through 1979 with those for the Seattle, Wash, center in the special National Cancer Institute survey of nonmelanoma skin cancer conducted in 1977 and 1978.[10] Comparison with Seattle seemed best because it was the closest area for which these data were available and the white population of that area is ethnically similar to that of Portland. The KP age-adjusted rates for squamous cell cancers were 27.5 and 101.6 per 100 000 for males and females, respectively. The corresponding rates from the survey were 16.1 and 46.6 per 100 000. Seattle is also a center in the Surveillance, Epidemiology, and End Results registry program, an ongoing program of population-based tumor registries maintained by the National Cancer Institute in several areas of the United States. The figures published by this program allow a comparison of melanoma rates with those from KP. The published rates for melanoma from the Seattle center[9] were 6.9 and 7.4 per 100 000 for the period 1974 through 1977. Rates calculated for the same period for KP were 13.8 per 100 000 for both sexes, indicating a twofold difference similar to that noted for squamous cell cancers.

The magnitude of these differences between populations from two areas with similar latitudes and similar county-specific mortality rates for malignant melanoma[11] was surprising. This could

indicate some artifact in calculation of the KP rates. However, as noted, cases were specifically tabulated in the same manner as done in these other surveys. In addition, while performing biopsies of all suspicious skin lesions has been routine at KP, there have been no aggressive screening programs. However, increased attention to all skin lesions by both physicians and patients may have led to more biopsies being done and greater likelihood of finding skin cancer.

Two other possibilities for the very high rates of melanoma and squamous cell skin cancer should be considered. First, it is possible that a routine practice of biopsy of all suspicious lesions, coupled with a centrally enforced policy of pathological review of all biopsy material within a completely record-linked system of outpatient and inpatient care, might more accurately reflect the true incidence of these conditions. Second, and perhaps more plausibly, the incidence of these conditions in the employed middle class, the typical population enrolled in a health maintenance organization, may be greater than that of the general population.[12,13] In either case, the implications are ominous: for at least one major segment of the population, these cancers and their increases over time are even a greater public health problem than we have anticipated.

It is possible that our estimates of the KP population at risk could be low and rate calculations as a consequence falsely high. This also does not seem likely since these populations have been used by the KP administration in the monitoring of all aspects of the program, and have been used in calculating seemingly accurate disease incidence for other conditions as well.[14] In addition, the pattern of rates for malignancies since 1960 in the KP population are almost identical to those from the tumor registry in the state of Connecticut, the only source of comparison rates over the entire time period.[4] Comparing KP with Connecticut for the period 1960 through 1979, one sees similar rates over time for malignancies that have risen rapidly—such as lung cancer among men (KP rates increased from 54.8 to 79.0 per 100 000 while Connecticut rates went from 54.0 to 80.9 per 100 000)—and for those malignancies that have remained relatively stable over the years, such as colon cancer among men (KP rates from 39.5 to 42.4 per 100 000 and Connecticut rates from 37.1 to 45.9 per 100 000). For tumors other than skin cancers that show marked regional variations, the KP rates have also tended to be similar to the western registries in the Surveillance, Epidemiology, and End Results program. For example, in the western United States where the practice of estrogen replacement therapy for menopause had been particularly common, and the resultant endometrial cancer rate in the middle to late 1970s had been particularly prominent, the KP rate for 1975 through 1979 was 47.5 per 100 000, while rates for Seattle and San Franciso Surveillance, Epidemiology, and End Results programs were 40.2 and 45.0 per 100 000, respectively. Thus, we feel that the rates reported here for skin cancers accurately reflect the incidence of these malignancies within the KP population.

There is a plausible, common explanation for the time trends seen for squamous cell carcinoma and malignant melanomas of the skin. We may be seeing the result of a widespread change in lifestyle, with substantially greater volitional exposure to sunlight by succesive generations of middle-class Oregonians. Because of the consistency of the increases seen by sex and age, and the likelihood that different aspects of sun exposure are responsible for these two forms of skin cancer, these changes in life-style must have been very broad. Specifically, they must have involved modifications in clothing and recreational activity affecting both men and women and must have involved changes over the life span of successive generations. This would encompass more frequent blistering burns as children (the reportedly critical sun-exposure–related variable for melanoma risk) and more cumulative chronic exposure to sunlight as adults (the apparently important variable for squamous cell skin cancers).

The sharp rise in truncal melanomas cannot easily be explained as an artifact of more careful examination of this area of skin during the course of routine visits and more frequent biopsies of suspicious lesions. Indeed, the seemingly disproportionate increase in truncal melanomas compared with squamous cell cancers of this anatomic site may be more consistent with changes in patterns of exposure: the trunk would more likely be involved in changing episodic recreational exposure than in chronic, long-term sun exposure over time.

Because this increasing incidence involves both the young and the old, these changes must have also begun a long time ago. While much of this is consistent with anecdotal reports, we know of no objective documentation of such lifestyle changes, and perhaps collection of such information would be worthwhile.

It is important to identify the reasons for these time trends for the aggressive pursuit of primary prevention of sun-induced cancers. Once known, these reasons might force us to reconsider estimates of the impact of nonvolitional exposure to ultraviolet light, such as that occurring as a result of ozone depletion. In addition, regardless of the causes of these increases, the recognized diminished morbidity and mortality associated with early recognition and treatment of both melanoma and squamous cell cancers support the current enthusiasm for increased professional and lay education focused on early diagnosis. Such measures might appropriately focus, at least in part, on those individuals known to be at particularly high risk for melanoma,[15] for example those with the dysplastic nevus syndrome.[16]

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